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The Performance of Naval Reserve Officers Training Corps
Graduates at the Surface Warfare Officers School
Division Officer Course

by

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Lieutenant, United States Navy
B.S., United States Naval Academy, 1986

Submitted in partial fulfillment
of the requirements for the degree of

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from the

ABSTRACT

Department of Defense budget cuts and force reductions have created the need to maximize the efficiency of the Naval Reserve Officers Training Corps (NROTC) program. This thesis addresses one dimension of NROTC productivity by analyzing the performance of program graduates at one of the Navy's post-accession schools. Specifically, this study evaluates the performance of NROTC graduates at the Surface Warfare Officers School Division Officer Course (SWOSDOC) located in Coronado, California. Based on the results of this study, the performance of NROTC graduates at SWOSDOC is higher than it has ever been. The performance of SWOSDOC classes as a whole is also higher than in the past as indicated by higher overall GPAs and very low attrition and setback rates.

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I. INTRODUCTION

The Naval Reserve Officers Training Corps (NROTC) program has recently experienced restructuring of a number of units at universities and colleges around the country. In the context of force downsizing, further consolidation and disestablishment of NROTC units may be necessary. At a minimum, budget cuts and force reductions have created the need to maximize the efficiency and effectiveness of unit operations.

The current budget situation has created a need for an objective basis on which to evaluate the performance of each NROTC unit. Decision makers need to be able to determine the relative standing of the units in order to provide feedback needed for performance improvement and to assess the viability of the unit. This thesis addresses one dimension of NROTC productivity by analyzing the performance of program graduates at one of the Navy's post-accession schools. Specifically, this study evaluates the performance of NROTC graduates using data obtained from Surface Warfare Officers School Division Officer (SWOSDOC) Course located in Coronado, California.

The performance of NROTC graduates at SWOSDOC is evaluated using the criterion-based test (CT) scores achieved in 27 different subject areas (Table 1) (NOTE: CTs 8 and 9 are

practical, hands-on modules and are not graded using the criterion-based test; There is no CT 17.) The data are grouped by SWOSDOC academic subject area, NROTC unit,

TABLE 1. SWOSDOC ACADEMIC MODULES

<u>MODULE</u>	<u>TOPIC</u>
1.	MANEUVERING BOARD
2.	DECK SEAMANSHIP
3.	BRIDGE WATCHSTANDING
4.	CIC WATCHSTANDING
5.	NAVAL COMMUNICATIONS
6.	RULES OF THE ROAD
7.	PILOTING AND DETECTION SYSTEMS
10.	PROPAGATION AND DETECTION SYSTEMS
11.	ENGAGEMENT SYSTEMS
12.	COMMAND AND CONTROL SYSTEMS
13.	MARITIME STRATEGY AND U.S. ASSETS
14.	NAVAL WARFARE OPERATIONS
15.	THE THREAT
16.	MAINTENANCE AND OPERATIONAL READINESS
18.	STEAM ENGINEERING
19.	GAS TURBINE/DIESEL ENGINEERING
20.	SHIPBOARD AUXILIARY SYSTEMS
21.	DAMAGE CONTROL I
22.	DAMAGE CONTROL II
23.	OOD INPORT
24.	PERSONNEL ORGANIZATION AND ADMINISTRATION
25.	DIVISION OFFICER COUNSEL & ADVISE
26.	TRAINING
27.	INSPECTIONS AND SAFETY
28.	PMS
29.	MDS/SUPPLY
30.	CORRESPONDENCE

SOURCE: SWOSDOC, Coronado, California

college major and SWOSDOC class number to show relationships between the NROTC units and SWOSDOC performance. This study will answer the following questions:

1. Are certain SWOSDOC academic modules more difficult for NROTC graduates than others?
2. Do performance scores at SWOSDOC differ as a function of NROTC unit?
3. Do performance scores at SWOSDOC differ as a function of college major?
4. Do performance scores at SWOSDOC differ as a function of SWOSDOC class?

A. NAVAL RESERVE OFFICERS TRAINING CORPS (NROTC)

The NROTC program is the largest single accession source of Regular Navy officers. The current level of accessions is 1,600 officers annually, but will be reduced to 1,100 by FY 1995 to meet Congressional requirements. Failure to adjust the number of units would result in smaller, less viable units and an unacceptable increase in the cost per NROTC commission. Consequently, the number of NROTC units will be reduced from its current level of 66 to 53 by FY 1995, a reduction that keeps the Navy's reserve officer production in balance with accession goals and scholarships.[Ref. 1: p. 40]

The NROTC scholarship program was established to educate and train qualified young men and women for service as commissioned officers in the Regular Navy. Selected high school students are awarded scholarships through a highly

competitive national selection process. The Navy's four-year scholarship program uses a two step process in selecting students: initial screening, followed by final selection. SAT or ACT scores serve as the sole criterion for initial screening. Those who qualify are then reviewed by a selection board. During the 1987-88 school year, initial selection required a score of at least 950 on the SAT (450 Verbal and 500 Math), or 42 on the ACT (19 English and 23 Math). Applicants who achieve the minimum required test scores are then evaluated on the basis of several weighted factors: SAT or ACT scores (19 percent); high school rank (56 percent); results of a structured interview by a Navy officer (10 percent); results of the Strong-Campbell Interest Inventory, used to predict career tenure (9 percent); and scores derived from a biographical questionnaire designed to predict retention (5 percent).[Ref.2;p. 53]

There is also a non-scholarship portion of the NROTC program which is called the college program. College program students are selected by the individual units, and standards vary by unit. There are no centrally established admission criteria. (Selection for scholarship programs of less than four years also takes place within various units, with no uniform criteria.) [Ref.2; p.54]

Those students selected for the program receive tuition, fees, and books, as well as a \$100 per month subsistence allowance. The cost per student can amount to more than

\$70,000 over the four years of the program at the participating colleges and universities (Table 2).

NROTC midshipmen lead on-campus lives very similar to those of their civilian counterparts. They pursue the college or university of their choice, provide their own room and board, and pursue academic studies leading to a bachelors degree in the major of their choice. They differ from other students in that they participate in weekly drill sessions where they wear government provided uniforms, naval science courses, and annual summer training periods, as well as conduct themselves in a military manner. They are not, however, subject to the Uniform Code of Military Justice as are midshipmen at the U.S. Naval Academy.[Ref. 3:p. IV-21]

The NROTC program is completely voluntary. Midshipmen may decide to discontinue participation in the program at any time during their first year. This is granted automatically and no service obligation is incurred. Upon beginning their second year in the program midshipmen enter into an agreement with the Department of the Navy to serve on active duty after graduation. Disenrollment from the NROTC program during the remaining three years can place the student on active duty in an enlisted status, usually for a period of two years. [Ref.3;pp.III-28,29]

TABLE 2. PARTICIPATING COLLEGES AND UNIVERSITIES

<u>STATE</u>	<u>NROTC UNIT</u>
Alabama	Auburn University
Arizona	University of Arizona
California	University of California at Berkeley University of California at Los Angeles University of San Diego/SDSU University of Southern California
Colorado	University of Colorado
District of Columbia	George Washington University
Florida	Florida A&M University Jacksonville University University of Florida
Georgia	Georgia Institute of Technology Morehouse College Savannah State College
Idaho	University of Idaho
Illinois	Illinois Institute of Technology Northwestern University University of Illinois

<u>STATE</u>	<u>NROTC UNIT</u>
Indiana	Purdue University University of Notre Dame
Iowa	Iowa State University
Kansas	University of Kansas
Louisiana	Southern University and A&M College Tulane University
Maine	Maine Maritime Academy
Massachusetts	Boston University College of Holy Cross Massachusetts Institute of Technology
Michigan	University of Michigan
Minnesota	University of Minnesota
Mississippi	University of Mississippi
Missouri	University of Missouri
Nebraska	University of Nebraska

<u>STATE</u>	<u>NROTC UNIT</u>
New Mexico	University of New Mexico
New York	Cornell University State University of New York - Maritime Rensselaer Polytechnic Institute University of Rochester
North Carolina	Duke University University of North Carolina
Ohio	Miami University Ohio State University
Oklahoma	University of Oklahoma
Oregon	Oregon State University
Pennsylvania	Carnegie-Mellon University Pennsylvania State University University of Pennsylvania Villanova University
South Carolina	The Citadel University of South Carolina
Tennessee	Memphis State University Vanderbilt University

STATENROTC UNIT

Texas	Prairie View A&M University
	Rice University
	Texas A&M University
	Texas Tech University
	University of Texas
Utah	University of Utah
Vermont	Norwich University
Virginia	Hampton University
	Norfolk State University
	Old Dominion University
	University of Virginia
	Virginia Military Institute
	Virginia Polytechnic University
Washington	University of Washington
Wisconsin	Marquette University
	University of Wisconsin

Source: 1992 NROTC College Scholarships Bulletin

The NROTC course objectives are developed from the Minimum Professional Core Competencies (MPCC) Manual for Officer Accession Programs. The NROTC program, as are all Navy officer accession programs, is designed to produce junior officers with a basic knowledge of the naval profession and to provide moral, mental, and physical development. The program's goal is to instill in each graduate the highest ideals of duty, loyalty, and honor in order to provide officers who have potential for future development of mind and character to assume the highest responsibilities of citizenship, military command and government service.

The MPCC manual provides the professional competencies for developing course objectives for all officer accession programs. The competencies are based upon fleet requirements and are the minimum which should be attained for the program. The composite of all classroom and practical instruction provides the basis for the development of a sense of dedication and commitment to the naval service and establishes personal standards of excellence which will remain with the graduate through his or her professional career. Program emphasis is directed toward providing a foundation for future training, education, and professional growth.[Ref. 4;p.ii]

Each NROTC midshipman must complete one year of calculus by the end of his or her sophomore year, one year of calculus-based physics by the end of the junior year, one year of English, one computer science course, and two or more courses

concentrating on American Military Affairs and National Security. In addition to these courses, midshipmen must complete the following Naval Science courses:

- **INTRODUCTION TO NAVAL SCIENCE.** A general introduction to the naval profession and to concepts of seapower. Instruction emphasizes the mission, organization, and warfare components of the Navy and Marine Corps. Included is an overview of officer and enlisted ranks and rates, training education, and career patterns. The course also covers naval courtesy and customs, military justice, leadership, and nomenclature. This course exposes the student to the professional competencies required to become a naval officer.
- **NAVAL SHIP SYSTEMS I - ENGINEERING.** A detailed study of ship characteristics and types including ship design, hydrodynamic forces, stability, compartmentation, propulsion, electrical and auxiliary systems, interior communications, ship control, and damage control. Included are basic concepts of the theory and design of steam, gas turbine, and nuclear propulsion. Also discussed are shipboard safety and fire fighting.
- **NAVAL SHIP SYSTEMS II - WEAPONS.** This course outlines the theory and employment of weapons systems. The student explores the processes of detection, evaluation, threat analysis, weapon selection, delivery, guidance, and explosives. Fire control systems and major weapons types are discussed, including capabilities and limitations. The physical aspects of radar and underwater sound are described in detail. The facets of command, control, and communications are explored as a means of weapons system integration.
- **SEAPOWDER AND MARITIME AFFAIRS.** A survey of U.S. naval history from the American Revolution to the present with emphasis on major developments. Included is an in-depth discussion of the geopolitical theory of Mahan. The course also treats present day concerns in seapower and maritime commerce, the law of the sea, the navy and merchant marine of the USSR, and a comparison of U.S. and Soviet maritime strategies.
- **NAVIGATION AND NAVAL OPERATIONS I.** An in-depth study of piloting and celestial navigation including theory, principles, and procedures. Students learn piloting

navigation including the use of charts, visual and electronic aids, and the theory and operation of magnetic and gyro compasses. Celestial navigation is covered in depth and includes the celestial coordinate system, an introduction to spherical trigonometry, the theory and operation of the sextant, and a step-by step treatment of the sight reduction process. Students develop practical skills in both piloting and celestial navigation. Other topics discussed include tides, currents, effects of wind and weather, plotting, use of navigation instruments, types and characteristics of electronic navigation systems, and the day's work in navigation.

- **NAVIGATION AND NAVAL OPERATIONS II.** A study of the United States and international rules of the nautical road, relative motion vector analysis theory, relative motion problems, formation tactics, and ship employment. Also included is an introduction to naval operations, ship behavior and characteristics in maneuvering, applied aspects of ship handling, and afloat communications.
- **EVOLUTION OF WARFARE.** This course traces historically the development of warfare from the dawn of recorded history to the present, focusing on the impacts of major military theorists, strategists, tacticians, and technological developments. The student develops a basic sense of strategy, develops an understanding of military alternatives, and sees the impact of historical precedent on military thought and action.
- **NAVAL LEADERSHIP AND MANAGEMENT I.** A comprehensive advanced-level study of organizational behavior and management in the context of the naval organization. Topics include a survey of the management functions of planning, organizing, and controlling; an introduction to individual and group behavior in organizations; and an extensive study of leadership and motivation. Major behavioral theories are explored in detail. Practical applications are explored by experimental exercises, case studies, and laboratory discussions. Other topics developed include decision making, communication, responsibility, authority, and accountability.
- **NAVAL LEADERSHIP AND MANAGEMENT II.** The study of naval junior officer responsibilities in naval administration. The course exposes the student to a study of counseling methods, military justice administration, naval human resources management, directives and correspondence, naval personnel administration, material management and maintenance, and supply systems. This capstone course

builds on and integrates the professional competencies developed in prior course work and professional training. [Ref. 3:pp. IV-8,9]

As members of the unit's Battalion of Midshipmen, students get their first chance to learn and develop the leadership abilities which are essential to the development of a quality naval officer. Initial leadership development comes from the examples set by upperclass midshipmen and officers assigned to the unit. As midshipmen rise through the ranks, they gain valuable leadership experience which will provide them with the proper techniques they will need in the fleet.

Other activities are available at the units to aid in professional development. Midshipmen are involved in intramural and intercollegiate athletics, military drill teams, and various campus societies and clubs. Midshipmen are also encouraged to join the fraternities and sororities on campus. These diverse organizations and activities are what many advocates of the program feel separates NROTC midshipmen from their counterparts at the U.S. Naval Academy (USNA). Program advocates feel that by taking part in these mainstream campus social activities, NROTC midshipmen mature faster than USNA midshipmen which helps them with their assimilation into the fleet.

Perhaps most important to the overall professional development of NROTC midshipmen is their participation in the summer training programs. The first summer training period

for midshipmen is the third class cruise which takes place between the freshman and sophomore years. During this cruise, midshipmen observe each major warfare community in order to help them decide which community they will enter upon graduation. Midshipmen receive Surface Warfare indoctrination in Norfolk, Virginia. They spend several days onboard ship and learn about weapon systems, anti-submarine warfare, and anti-air warfare. Amphibious training with the Navy and Marine Corps is held at Little Creek, Virginia. During this time they learn what is needed to make an amphibious operation work, how to operate some of the basic weapons used by the Marine Corps, and get the chance to participate in an amphibious landing. Submarine Warfare indoctrination takes place in Charleston, South Carolina where midshipmen spend several days on a nuclear submarine, learning about tactics, torpedoes, and ballistic missiles. Aviation indoctrination presents midshipmen with the opportunity for "hands on" training in the Navy's training aircraft and aircraft simulators.

Between their sophomore and junior years, midshipmen take part in the second class cruise where they are assigned to a ship where they learn first hand what Navy life onboard ship is all about. They may be assigned to any class of ship or submarine, and work as enlisted personnel so that they can obtain the enlisted point of view and understand the crew's duties.

Upon completing their junior year, midshipmen take part in the first-class cruise. They go back to sea, but this time acting as junior officers. They perform the duties and assume the responsibilities of junior officers, using the leadership skills and professional knowledge gained during the three previous years at the unit.

B. SWOS DIVISION OFFICER COURSE

In response to a Task Force Study on Navy and Marine Corps personnel retention, the Surface Warfare Officer's School (SWOS) was established at the Naval Education Training Center, Newport, R.I. in 1970. Expansion of the program scope, content, and student load was approved in 1973, including the formation of a Surface Warfare Officer's School at Coronado, California.

On 1 January, 1975 SWOS merged with the Destroyer School under the newly established Surface Warfare Officer's School Command. This organization integrates the entire continuum of warfare specialty training, from basic through advanced for Surface Warfare Officers.

The mission statement of the Surface Warfare Officer's School Division Officer Course (SWOSDOC) reads as follows:

"To prepare newly commissioned line officers for junior officer assignments in surface warfare units and provide a practical foundation for attainment of qualification and subsequent designation as Surface Warfare Officers."

The SWOSDOC curriculum is comprised of the academic modules shown in Table 1. The basis for evaluation of an officer's performance and the achievement of each module's learning objectives is a criterion-referenced examination system applied through a series of tests administered at the end of each module's course of instruction.

Successful completion at SWOSDOC is the first step toward qualification as a Surface Warfare Officer (SWO). The instruction received at SWOSDOC prepares junior officers with the basic knowledge and skills required to begin the SWO qualification process during their initial sea tour.

II. LITERATURE REVIEW

The current budget situation in the Department of Defense has created a need for an objective basis on which to evaluate the performance of each NROTC unit and the efficiency and effectiveness of the NROTC program as a whole. A review of related literature has revealed that similar research projects have been undertaken to ensure the NROTC program is administered to maximize effectiveness and efficiency in its primary role of preparing newly commissioned officers for sustained superior performance in the fleet.

The first step in ensuring that the naval service is getting the finest possible officers is to recruit the best and brightest candidates for induction into the NROTC program. Eitelberg (1989) found that colleges and universities hosting NROTC units are "above-average" institutions. This study found that the Navy has ROTC units at the most competitive schools (on average) of all the armed services. The average SAT score (combined Math and Verbal) for the schools hosting NROTC units was 1083, compared with a national average of less than 950 for all college freshman. It was also observed that the NROTC universities had a greater advantage on the SAT Math than the SAT Verbal, which reflects the Navy's preference for officers with a technical and scientific background.

Several recent studies have identified ways in which the Department of Defense can improve the ROTC selection process. Owens-Kurtz (1989) detailed suggestions for improving the selection of NROTC candidates, including the development and validation of a new candidate Biographical Questionnaire. The NROTC program currently uses a biographical questionnaire that carries a weight of 5 percent of the total criteria used for selection into the program. Smith (1990) found that the use of psychological tests and the establishment of an automated person-job matching system could improve the Air Force's selection of AFROTC candidates.

Once the best possible candidates have been selected for induction into the NROTC program, attrition of these midshipmen from the program must be kept at a minimum. As Borman (1989) has indicated, attrition from the NROTC program typically runs at 50 percent for the four-year training period each entering class of midshipmen must complete prior to commissioning. A study by Neumann (1986) is especially interesting in her categorization of different types of student attrition. Three types of attrition were examined in her study, including voluntary resignation, all disenrollment, and academic disenrollment only. The SAT Verbal, SAT Math, and high school class rank were each found to be good at predicting academic disenrollment, with point-biserial correlations of .21, .37, and .29, respectively. On the other hand, all three predictors were also the least effective in

predicting voluntary resignation, with negative correlations in two cases. All disenrollment showed relatively small correlations with the aptitude predictors, near .10 or less. A consistent finding in military studies that attempt to validate aptitude test scores with attrition is that quantitative composites are generally better than verbal composites in predicting who will finish the course of instruction. This may relate to the fact that scientific and technical subjects are emphasized to a great extent in the military's training and education programs.[Ref.2;p.62]

In order to keep the costs of the NROTC program low, while still producing the number and quality of officers required in the fleet, the 50 percent attrition rate should be lower. Both Borman and Kantor (1989) found reasons for the high levels of attrition, but also recommended further research be conducted in order to better understand the motivational and other factors that cause midshipmen to leave the NROTC program prior to completion.

Once NROTC graduates have been commissioned it is imperative that their performance be monitored in order to ensure that the training they receive at their respective units is adequate to prepare them for successful completion of their initial training and subsequent billets in the fleet. This study reviews the performance of NROTC graduates at SWOSDOC, with emphasis placed on their performance in the individual SWOSDOC academic modules.

Heidt and Zajkowski (1982) conducted a similar study that measured the performance of NROTC graduates in post-accession training in the Surface, Aviation, Submarine and Supply Corps communities. Using a database describing 1,139 NROTC graduates that entered the SWOS Basic Course (now known as SWOSDOC) between FY 1977 and FY 1980, Heidt and Zajkowski observed the following characteristics of NROTC graduates:

- A mean CT score (GPA) of 3.50 (Standard Deviation (S.D.) = .49; 4.0 scale).
- Setback and Attrition rates of 2.9 and 7.9 percent, respectively.
- CT scores grouped by NROTC unit attended, academic major, and class year produced GPAs ranging from 3.09 to 3.77.

Heidt and Zajkowski determined NROTC graduate preparedness for SWOS Basic by utilizing data obtained from a diagnostic pretest that was administered to all students entering SWOS Basic. This test assessed the student's knowledge level as it reflected the curriculum objectives of the three major commissioning sources (NROTC, USNA, and the Officer Candidate School). It also identified specific academic areas where individual students needed remedial instruction and/or counseling. This pretest is no longer administered, so any future measure of NROTC graduate preparedness must be taken from the actual SWOSDOC academic module data.

Heidt and Zajkowski used the following institutional characteristics to better group the data on NROTC graduates:

- Geography (Northwest, West, East and South)
- Type (Multipurpose or Technical Universities, and Letters, Arts and Sciences (LAS) Institutions)
- Environment (Suburban, Urban, or Rural)
- Control (Public, Private, or Catholic)
- Salary (High, Average, or Low faculty salaries)
- Ethnic/Coed Status (Predominately Male or Minority enrollment)
- Size (Institution enrollment)
- Rank (Computed from the Barron's index from Noncompetitive to Most Competitive)

Heidt and Zajkowski found that NROTC graduates with non-technical majors were twice as likely to be set back as their counterparts with a technical background. In comparing technical and non-technical majors Heidt and Zajkowski also found that the CT scores of graduates with technical majors were equal to or higher than those of non-technical majors in all SWOS Basic academic subject areas.

Other items of interest suggested by the study of technical and non-technical majors were:

- rural institutions tend to produce a higher proportion of technical graduates
- LAS-oriented institutions produce technical and non-technical graduates in roughly the same proportion as do universities; technical institutions, of course, produce a high percentage of technically trained graduates

- the West, Midwest, and Southeast were about evenly split in their production of technical and non-technical graduates; however, more than 60 percent of the graduates from institutions in the Northeast were technically trained.

In studying the effects of NROTC unit on SWOS Basic performance, the Heidt and Zajkowski study showed that public colleges/universities demonstrated setback rates three times greater than private non-Catholic or Catholic institutions.

Significant differences in mean CT scores among categories comprising each institutional characteristic were found for only two variables: (1) the differences in mean scores among the competitive ranks of the Barron's scale continued in essentially the same order, that is, those graduates of institutions with higher Barron's scale ratings achieved higher performance scores at SWOS Basic, and (2) a significant difference in mean CT scores achieved by graduates of predominately minority vs. predominately majority institutions was found. This wasn't totally unexpected in that the four institutions that had a predominately minority enrollment were more likely to be rated as "less competitive" in Barron's ranking.

The Heidt and Zajkowski study looked at subjects who attended SWOSDOC between FY 1977 and FY 1980. This study is very similar to the Heidt and Zajkowski study, but will be an updated review of the subject area. The subjects in this study attended SWOSDOC between FY 1989 and FY 1992. This

study will go one step further than the Heidt and Zajkowski study by identifying the actual academic modules in which the NROTC graduates are found to be having the most difficulty. Results of this study may be useful for the Chief of Naval Education and Training in reviewing the NROTC program's core curriculum and, if necessary, revising it to ensure the knowledge gained at the NROTC unit is sufficient in preparing graduates for successful completion of the SWOSDOC course of instruction.

III. METHODOLOGY

A. DATA BASE AND SUBJECTS

The data base used in this study was obtained from SWOSDOC Coronado, California. The data base includes the Social Security Number, SWOSDOC class number, NROTC unit, college attended, college major, college GPA, individual SWOSDOC academic module GPA and the overall SWOSDOC GPA for 1,022 NROTC graduates that entered SWOSDOC between 1989 and 1992. These 1,022 NROTC graduates attended SWOSDOC immediately upon graduation from their respective colleges and universities. This group was chosen because of changes to the SWOSDOC curriculum made in the late 1980s that revised the course of instruction into the arrangement of courses as listed in Table 1. Since the revision, SWOSDOC has maintained a data base on each officer that began the course of instruction. It was this data base that was utilized in this study.

During this period, at least one NROTC graduate entered SWOSDOC from every college and university listed in Table 2. The graduates entered SWOSDOC with extremely varied educational backgrounds. The sample sizes for each NROTC unit ranged from 6 (VPI) to 33 (Texas A&M) (see Table 5). The most common major was political science (N = 86) and the least common was management (N = 17) (see Table 7).

B. PROCEDURE

1. DATA ELEMENTS

The following variables were the primary elements used in the formation of the data set and the actual data analyses:

- SSN: the social security number of each NROTC graduate was used to identify each data observation.
- Class: the SWOSDOC class number was used to identify each of the individual classes in order to develop a trend in performance of NROTC graduates for the period under observation. There were 19 classes during the 1989-1992 period. Each class is 16 weeks in duration. Six classes are held each fiscal year.
- College: the college attended by the NROTC graduates was used to group SWOSDOC GPAs by college to aid in the relative rankings of NROTC units by SWOSDOC performance measures.
- Grade Point Average: this is the overall SWOSDOC GPA for each individual NROTC graduate based upon the average of all GPAs for the criterion-based tests administered at SWOSDOC. These were also grouped by accession source and used in the comparison of all three major accession sources. These were grouped by NROTC unit and used in the development of a relative ranking of all units that had a sufficient number of graduates during the period under observation. The GPAs were also grouped by academic major to achieve a similar ranking of majors.
- SWOSDOC Academic Module GPA: this is the grade point average (CT score) for each of the 27 SWOSDOC academic modules listed in Table 1. They were used to determine which, if any, of the courses taught at SWOSDOC were more difficult than the others for the NROTC graduates.
- Attrition: this is the rate at which NROTC graduates were removed from the SWOSDOC curriculum by class. Individual attrition data and reasons for individual attritions were not available.

- Setback: this is the rate at which NROTC graduates were removed from his or her original class and entered into another class at a later date. Individual setback data and reasons for individual setbacks were not available.

2. APPROACH

The overall performance of NROTC graduates at SWOSDOC is described by mean GPA for the complete set of academic modules taught at SWOSDOC. The mean GPA for each SWOSDOC academic module was computed and compared to the overall GPA to determine the relative difficulty of courses taught at SWOSDOC. In order to identify those courses which were most difficult, paired comparison tests of the module means were computed. The paired comparison tests were used to test whether the difference in the values of the academic module mean GPA and the overall mean GPA were significantly different from zero. This was done by creating a new variable containing the differences between the paired variables (module mean GPA and overall mean GPA), and using SAS, a statistical software package, to run t-tests.

Where the size of individual NROTC unit samples was large enough, mean GPA by unit was computed, and paired comparison tests were used to determine if the mean difference between each NROTC unit mean GPA and overall mean GPA was significantly different from zero.

Where the number of NROTC graduates grouped by college/university major was large enough, mean GPA by major

was computed. Paired comparison tests were then used to analyze the significance of differences between mean GPA and overall GPA by major.

Performance by SWOSDOC class number was described by using overall GPA by class. This method was also used in comparing the three performance of the three major accession sources at SWOSDOC. Attrition and setback data by class were also generated.

C. APPARATUS

The actual data analyses and report printouts were generated at the Naval Postgraduate School (NPS), Monterey, California, Church Computer Center utilizing the SAS statistical software package, version 6. The data base provided by SWOSDOC, Coronado, California, was in a flat file format and was encoded into SAS readable format at the NPS Computer Center.

IV. RESULTS & DISCUSSION

A. ACADEMIC MODULES

The performance of NROTC graduates at SWOSDOC is described by criterion-based test (CT) scores in the 27 subject areas listed in Table 1. Using 1,022 observations obtained from SWOSDOC Coronado, California, NROTC graduates entering SWOSDOC between FY 1989 and FY 1992 achieved an overall mean GPA of 3.65 (on a 4.0 scale) with a standard deviation of .13. As detailed in Table 3, mean GPA for each of the 27 SWOSDOC academic modules ranged from 3.51 to 3.78, and the standard deviation ranged from .15 to .42.

Paired comparison tests were computed to determine if the mean GPA of each module was significantly different from the overall mean GPA for all modules. Table 4 gives a complete description of the results of the academic module paired comparison tests. The column labeled "DIFF" is calculated as the difference between the overall GPA and the module GPA. Positive differences are interpreted as indicating the module is more difficult; negative differences as less difficult. The t-statistic in column 4 indicates whether these differences are statistically significant.

The tests resulted in the conclusion that the following modules were significantly more difficult at the probability level (P) < .0001: Maneuvering Board, Piloting/Detection Systems, Gas Turbine/Diesel Engineering, and Shipboard Auxiliary Systems. The following academic modules were found to be less difficult at the probability level (P) < .0001: Deck Seamanship, Bridge Watchstanding, Naval Communications, Rules of the Road, The Threat, Maintenance & Operational Readiness, OOD Inport, PMS, MDS/Supply, and Correspondence.

The results in Table 4 are not surprising. The most difficult academic modules for NROTC graduates are those associated with more technical, engineering-based concepts and the often difficult-to-grasp, foreign concepts associated with the maneuvering board and piloting and detection systems. The less difficult academic modules are those associated with concepts that should be relatively easy for NROTC graduates to comprehend.

The overall GPA of 3.65 achieved by the NROTC graduates is much higher than expected based on previous research. The Heidt and Zajkowski study found the overall GPA for graduates attending SWOS Basic between FY 1977 and FY 1980 to be 3.50. Data prepared by the SWOS Basic School for NROTC graduates attending SWOS Basic between FY 1976 and FY 1980 (1,758 cases) showed those graduates attaining an overall GPA of 3.438 [Ref. 5:p. 30]. This "grade increase" can possibly be attributed to the revisions to the SWOSDOC curriculum that

separated many of the subjects taught in the late 1970s and early 1980s into shorter, more easily understood modules. Another factor may be the improved NROTC selection process that has continued through this period to become more and more competitive, thereby ensuring a higher quality end product entering the fleet upon graduation from the unit.

TABLE 3. MEAN GPAs FOR SWOSDOC ACADEMIC MODULES

<u>MODULE</u>	<u>TOPIC</u>	<u>MEAN GPA</u>	<u>S.D.</u>
CT01	MANEUVERING BOARD	3.585557	.41747
CT02	DECK SEAMANSHIP	3.763698	.19556
CT03	BRIDGE WATCHSTANDING	3.713663	.20557
CT04	CIC WATCHSTANDING	3.668684	.29153
CT05	NAVAL COMMUNICATIONS	3.878169	.15238
CT06	RULES OF THE ROAD	3.823933	.17411
CT07	PILOTING/DETECTION SYSTEMS	3.561341	.32083
CT10	PROPAGATION/DETECTION SYS.	3.644231	.27893
CT11	ENGAGEMENT SYSTEMS	3.650063	.26676
CT12	COMMAND/CONTROL SYSTEMS	3.636115	.26706
CT13	MARITIME STRATEGY/ US ASSETS	3.653894	.26520
CT14	NAVAL WARFARE OPERATIONS	3.679463	.23929
CT15	THE THREAT	3.729452	.22562
CT16	MAINTENANCE/OP. READINESS	3.753874	.23449
CT18	STEAM	3.625249	.28539
CT19	GAS TURBINE/DIESEL	3.512262	.30301
CT20	SHIP AUXILIARY SYSTEMS	3.600274	.25283
CT21	DAMAGE CONTROL I	3.662579	.22863
CT22	DAMAGE CONTROL II	3.671503	.24265
CT23	OOD INPORT	3.768258	.19750
CT24	PERSONNEL/ADMINISTRATION	3.666019	.21762
CT25	DIVISION OFFICER	3.652607	.26222
CT26	TRAINING	3.631085	.24188
CT27	INSPECTIONS AND SAFETY	3.672756	.20486
CT28	PMS	3.784686	.22504
CT29	MDS/SUPPLY	3.732099	.19154
CT30	CORRESPONDENCE	3.650578	.25372

TABLE 4. PAIRED COMPARISON TESTS OF MODULE GPAs

MODULE	DIFF	STD. ERROR	T-STATISTIC	P
CT01	0.0650206	0.0130588	4.9790658	0.0001
CT02	-0.1131203	0.0061174	-18.4914809	0.0001
CT03	-0.0630849	0.0066697	- 9.4584850	0.0001
CT04	-0.0181059	0.0094588	- 1.9141919	0.0559
CT05	-0.2275909	0.0056752	-40.1024468	0.0001
CT06	-0.1733552	0.0054465	-31.8285461	0.0001
CT07	0.0892365	0.0100408	8.8874241	0.0001
CT10	0.0063472	0.0087296	0.7270871	0.4673
CT11	0.0005151	0.0086551	0.0595189	0.9526
CT12	0.0144628	0.0083540	1.7312452	0.0837
CT13	-0.0033160	0.0082957	- 0.3997296	0.6894
CT14	-0.0288849	0.0077637	- 3.7205198	0.0002
CT15	-0.0788738	0.0073241	-10.7690728	0.0001
CT16	-0.1032965	0.0073351	-14.0824440	0.0001
CT18	0.0253285	0.0089317	2.8357982	0.0047
CT19	0.1383158	0.0094829	14.5857536	0.0001
CT20	0.0503043	0.0079087	6.3606342	0.0001
CT21	-0.0120014	0.0072156	- 1.6632571	0.0966
CT22	-0.0209242	0.0076542	- 2.7336824	0.0064
CT23	-0.1176804	0.0062300	-18.8894410	0.0001
CT24	-0.0154416	0.0068645	- 2.2494798	0.0247
CT25	-0.0020287	0.0082715	- 0.2452584	0.9063
CT26	0.0194926	0.0076338	2.5534698	0.0108
CT27	-0.0221779	0.0064623	- 3.4319065	0.0006
CT28	-0.1341086	0.0070396	-19.0507304	0.0001
CT29	-0.0815212	0.0060421	-13.4921593	0.0001
CT30	-0.0787610	0.0139036	- 5.6648127	0.0001

B. NROTC UNITS

Performance of NROTC graduates as grouped by NROTC unit is described by mean GPA for 713 observations from the 38 units in this sample that had 6 or more graduates. These graduates achieved a mean GPA of 3.652 with a standard deviation of .123. The mean GPAs by unit ranged from 3.56 to 3.75, and the standard deviations ranged from .09 to .15.

A complete description of mean GPAs for all 38 units evaluated is listed in Table 5. "MEAN" indicates the mean GPA for all of the observations from each of the units; "N" indicates the number of observations for each unit.

Paired comparison tests were computed to determine if the mean GPA of each NROTC unit was significantly different from the overall mean GPA for all units. A complete description of the results of the NROTC unit paired comparison tests are detailed in Table 6. The column labeled "DIFF" is calculated as the difference between the GPA for all units and the individual unit's GPA. Positive differences are interpreted as indicating the unit GPA is less than the overall mean GPA; negative differences as indicating the unit GPA is greater than the overall mean GPA.

The tests resulted in the conclusion that the following units had GPAs that were significantly greater than the overall mean : Duke University (GPA = 3.75; $P < .002$) and Cornell University (GPA = 3.71; $P < .009$). On the other hand, San Diego State University/University of California at San Diego (GPA = 3.58; $P < .003$) and VMI (GPA = 3.56; $P < .0008$) were the only units to attain mean GPAs significantly below the overall mean.

These scores are much higher than expected. The scores of the units with the lowest GPAs are still higher than the scores found for the overall GPA achieved by NROTC graduates in the Heidt and Zajkowski study. The range of GPAs grouped by unit is much smaller than the range found in the Heidt and Zajkowski study. The scores in the Heidt and Zajkowski study ranged from 3.09 to 3.78, and encompassed a greater number of units, with several units only having one graduate in the sample, which may have caused the greater range in scores. Selectivity bias may be the reason that Duke and Cornell had higher GPAs than the overall mean. These universities have higher entrance standards than most universities, and their graduates would be expected to perform at higher levels than graduates of universities with lower entrance standards. Similarly, those graduates of universities with lower entrance standards like San Diego State University/UCSD and VMI would be expected to have lower SWOSDOC performance scores than graduates of universities with higher entrance standards.

TABLE 5. NROTC PERFORMANCE AT SWOSDOC BY NROTC UNIT

<u>COLLEGE/UNIVERSITY</u>	<u>MEAN GPA</u>	<u>STD DEVIATION</u>	<u>N</u>
U ARIZONA	3.63921	0.10745	19
AUBURN	3.63334	0.12265	24
BOSTON U	3.64960	0.13152	15
U COLORADO	3.64248	0.11126	31
UC BERKELEY	3.69100	0.12888	28
UCLA	3.62113	0.11367	15
CORNELL	3.70951	0.11345	31
DUKE	3.74980	0.09783	15
U IDAHO	3.64020	0.12217	15
U ILLINOIS	3.68706	0.14227	16
MIT	3.70255	0.09940	18
U MICHIGAN	3.71013	0.11796	15
U MINNESOTA	3.71412	0.11357	17
U MISSOURI	3.61928	0.11881	14
U NEW MEXICO	3.63312	0.10433	16
NORTHWESTERN	3.66487	0.12523	16
NORWICH	3.55853	0.13508	15
NOTRE DAME	3.65071	0.14130	32
U OKLAHOMA	3.60313	0.10047	15
OREGON STATE	3.67427	0.11907	22
U PENNSYLVANIA	3.63125	0.13000	16
PENN STATE	3.69010	0.11916	29
PRAIRIE VIEW A&M	3.58643	0.14038	7
PURDUE	3.72745	0.14219	22
RPI	3.71516	0.11401	12
U ROCHESTER	3.66036	0.10531	22
SAN DIEGO STATE	3.57648	0.12689	31
USC	3.66962	0.11017	16
U TEXAS	3.65606	0.13998	16
TEXAS A&M	3.63190	0.13151	33
TEXAS TECH	3.58506	0.09602	15
VANDERBILT	3.65113	0.11420	15
VILLANOVA	3.59690	0.15390	21
U VIRGINIA	3.63573	0.09922	15
VMI	3.55890	0.10187	20
VPI	3.64800	0.08508	6
U WASHINGTON	3.66507	0.13095	27
U WISCONSIN	3.70120	0.12198	16
AVERAGE (N Total)	3.65163	0.11903	713

TABLE 6. PAIRED COMPARISON TESTS OF NROTC UNIT GPAs

<u>COLLEGE/UNIVERSITY</u>	<u>DIFF</u>	<u>STD ERR</u>	<u>T-STAT</u>	<u>P</u>
U ARIZONA	.012412	.025327	.490366	.6298
AUBURN	.020338	.025121	.809604	.4265
BOSTON U	.002030	.035152	.057749	.9548
U COLORADO	.009146	.002031	.045026	.6558
UC BERKELEY	-.03937	.024803	-1.5873	.1241
UCLA	.030497	.030382	1.00377	.3325
CORNELL	-.05789	.020715	-2.7945	.0090
DUKE	-.09817	.026148	-3.7544	.0021
U IDAHO	.011430	.032654	.450255	.7315
U ILLINOIS	-.03537	.036711	-.96347	.3506
MIT	-.05093	.024109	-2.1123	.0498
U MICHIGAN	-.05850	.031526	-1.8557	.0847
U MINNESOTA	-.06248	.028392	-2.2009	.0428
U MISSOURI	.032344	.032951	.981589	.3325
U NEW MEXICO	.018505	.026938	.686947	.5026
NORTHWESTERN	-.01325	.032335	-.40962	.6879
NORWICH	.093096	.036103	2.57864	.0219
NOTRE DAME	.000911	.025379	.035905	.9716
U OKLAHOMA	.048497	.026852	.606753	.0924
OREGON STATE	-.02264	.025984	-.87143	.3934
U PENNSYLVANIA	.020380	.033589	.606753	.5531
PENN STATE	-.03847	.022519	-1.7084	.0986
PRAIRIE VIEW A&M	.065201	.057311	1.13767	.2986
PURDUE	-.07583	.031029	-2.4436	.0235
RPI	-.06354	.034376	-1.8483	.0916
U ROCHESTER	-.00873	.022982	-.38002	.7077
SAN DIEGO STATE	.075146	.023168	3.24368	.0029
USC	-.01799	.028448	-.63257	.5365
U TEXAS	-.00443	.036145	-.12263	.9040
TEXAS A&M	.019660	.023248	.845676	.4040
TEXAS TECH	.066497	.025677	2.58973	.0214
VANDERBILT	.000497	.030523	.016272	.9872
VILLANOVA	.054725	.034433	1.58931	.1277
U VIRGINIA	.015897	.026519	.599439	.5585
VMI	.092680	.023371	3.96553	.0008
VPI	.003630	.038050	.095401	.9277
U WASHINGTON	-.01344	.025682	-.52347	.6051
U WISCONSIN	-.04962	.031495	-1.5755	.1360

C. COLLEGE MAJORS

The performance of NROTC graduates as grouped by academic major is described by mean GPA for 708 observations in the 19 most common majors observed in this study. The mean GPA for the 708 cases was 3.66 with a standard deviation of .13. The GPAs ranged from 3.61 to 3.73, and standard deviations ranged from .09 to .17. A complete description of GPAs for all 19 academic majors evaluated is listed in Table 7.

Paired comparison tests were computed to determine if the mean GPA of the NROTC graduates' college majors were significantly different from the overall mean GPA for all majors. A complete description of the results of the academic major paired comparison tests are detailed in Table 8. The column labeled "DIFF" is calculated as the difference between the overall GPA and the college major GPA. Positive differences are interpreted as indicating the major has a lower GPA than the overall mean; negative differences as indicating the major has a higher GPA than the overall mean.

The tests resulted in the following majors having mean GPAs greater than the overall mean :

Aerospace Engineering (GPA = 3.73; $P < .03$), Electrical Engineering (GPA = 3.72; $P < .0001$), and Mechanical Engineering (GPA = 3.69; $P < .01$). History (GPA = 3.621; $P < .02$) was the only academic major with a SWOSDOC GPA significantly below the overall mean.

These results are also not surprising. The technical nature of the SWOSDOC curriculum is geared towards officers with technically-oriented backgrounds, and those officers with technical academic majors would be expected to perform at a higher level. The range of GPAs as grouped by academic major for the NROTC graduates attending SWOS Basic from FY 1977 to FY 1980 detailed in the Heidt and Zajkowski study was between 3.13 and 3.93, with an overall mean of 3.50. The Heidt and Zajkowski study had a greater number of majors with several having a very small number of graduates used in the analysis, which could explain this larger GPA spread.

D. SWOSDOC CLASS

Table 9 details each of the SWOSDOC classes utilized in this study and their related overall mean GPAs, attrition and setback rates, and class size. The purpose of this table is to see if there is a pattern in performance over time, or if any cohort effects can be detected. Table 9 shows that the

overall performance by SWOSDOC class has remained relatively constant between 1989 and 1992. The overall setback and attrition rates were 1.1% and .95%, respectively. Setback rates have ranged from 0 to 2.6%, while the attrition rates have ranged from 0 to 2.4%.

These values are much lower than expected. The Heidt and Zajkowski study found setback and attrition rates for the NROTC graduates that entered SWOS Basic between FY 1977 and FY 1980 of 7.9% and 2.9%, respectively. The reason for the reduced attrition and setback rates may once again be the SWOSDOC curriculum revision and the changes in the NROTC program selection process.

TABLE 7. NROTC PERFORMANCE AT SWOSDOC BY COLLEGE MAJOR

<u>College Major</u>	<u>Mean GPA</u>	<u>Std Deviation</u>	<u>N</u>
AEROSPACE ENG	3.731474	0.131033	19
BIOLOGY	3.674286	0.111487	35
BUSINESS	3.633946	0.131345	37
CHEMISTRY	3.659348	0.142545	23
CIVIL ENG	3.632179	0.122526	28
COMPUTER SCI	3.662282	0.140357	39
ECONOMICS	3.648370	0.119835	46
ELECT. ENG	3.720810	0.105939	63
FINANCE	3.637368	0.143513	19
GENERAL ENG	3.651409	0.131090	22
HISTORY	3.621343	0.121679	67
INDUST. ENG	3.634261	0.107281	23
INT'L REL	3.672200	0.114916	25
MANAGEMENT	3.667588	0.086526	17
MATH	3.671714	0.131276	28
MECH ENG	3.694195	0.116936	82
PHYSICS	3.638483	0.167622	29
POLITICAL SCI	3.636651	0.126651	86
PSYCHOLOGY	3.612950	0.128072	20
AVERAGE	3.657940	0.125296	708

TABLE 8. PAIRED COMPARISON TESTS OF COLLEGE MAJOR GPAs

<u>MAJOR</u>	<u>DIFF</u>	<u>STD ERR</u>	<u>T-STAT</u>	<u>P</u>
AEROSPACE ENG	-.07353	.030885	-2.3809	.0285
BIOLOGY	-.01635	.019119	-.85490	.3986
BUSINESS	.023994	.021891	1.09607	.2803
CHEMISTRY	-.00141	.030391	-.04632	.9635
CIVIL ENG	.025761	.023580	1.09250	.2843
COMPUTER SCI	-.00434	.022769	-.19070	.8498
ECONOMICS	.009440	.017887	.527747	.6003
ELECT. ENG	-.06287	.013454	-4.6728	.0001
FINANCE	.020572	.033826	.608153	.5507
GENERAL ENG	-.00965	.021631	-.44603	.6616
HISTORY	.036597	.014978	2.44342	.0172
INDUST. ENG	-.01377	.025264	-.54521	.5901
INT'L REL	.044990	.029382	1.53122	.1422
MANAGEMENT	.019457	.031678	.614227	.5440
MATH	.023679	.022872	1.03527	.3118
MECH ENG	-.01426	.023457	-.60791	.5490
PHYSICS	.021289	.013737	1.54971	.1249
POLITICAL SCI	-.03325	.012981	-2.5618	.0123
PSYCHOLOGY	.006530	.028606	.228305	.8216

Table 9. PERFORMANCE OF NROTC GRADUATES BY SWOSDOC
CLASS NUMBER

<u>CLASS</u>	<u>MEAN GPA</u> <u>(4.0 SCALE)</u>	<u>SETBACKS</u>	<u>ATTRITIONS</u>	<u>N</u>
89003	3.67	2	1	130
89004	3.64	1	0	85
89005	3.67	2	1	47
89006	3.61	1	1	188
90001	3.65	4	1	154
90002	3.64	0	2	82
90003	3.69	1	0	79
90004	3.72	1	0	60
90005	3.76	1	0	52
90006	3.66	3	1	190
91010	3.61	1	1	135
91020	3.68	2	0	46
91030	3.64	2	2	103
91040	3.71	0	1	50
91050	3.68	0	0	21
91060	3.60	4	2	155
92010	3.60	2	2	99
92020	3.64	0	1	83
92030	3.65	0	1	34
TOTALS	3.66	27	17	1,793*

* This total includes all three major accession sources.

E. ACCESSION SOURCE COMPARISON

As shown in Table 10, the overall GPAs for all three major accession sources: NROTC, the U.S. Naval Academy (USNA) and the Officer Candidate School, are nearly equal. The ranges of scores within each accession source are also very small. The NROTC scores ranged from 3.60 - 3.76 (ST. DEV. = .0421), USNA scores ranged from 3.57 - 3.73 (ST. DEV. = .0334), and OCS scores ranged from 3.54 - 3.77 (ST. DEV. = .0699). These scores were gathered at SWOSDOC by accession source, and time limitations have prevented an analysis of the entire population needed to show variance. Therefore, no further statistical inference can be made as to the differences between the three accession sources.

The MPCC Manual for Officer Accession Programs (discussed in Chapter I) is used to develop the course objectives for all of the core professional courses taught at the three major accession sources. The goal of the MPCC manual is the standardization of all pre-commissioning training and to ensure that this training is commensurate with the educational objectives of the initial fleet training programs. Based upon the results listed in Table 10, it seems that these goals have been met as all three accession sources appear to perform equally well.

TABLE 10. PERFORMANCE OF NROTC, USNA & OCS ACCESSIONS BY
SWOSDOC CLASS NUMBER

<u>CLASS</u>	<u>NROTC</u>	<u>USNA</u>	<u>OCS</u>
89003	3.67	3.69	3.64
89004	3.64	3.68	3.64
89005	3.67	3.65	3.56
89006	3.61	3.65	3.54
90001	3.65	3.63	3.59
90002	3.64	3.67	3.68
90003	3.69	3.67	3.78
90004	3.72	3.73	3.77
90005	3.76	3.67	3.62
90006	3.66	3.66	3.65
91010	3.61	3.68	3.68
91020	3.68	3.63	3.63
91030	3.64	3.67	3.64
91040	3.71	3.57	3.75
91050	3.68	3.62	3.68
91060	3.60	3.63	3.63
92010	3.60	3.64	3.71
92020	3.64	3.64	3.60
92030	3.65	3.67	3.77
AVERAGES	3.6589	3.6584	3.6558
ST. DEV.	0.04214	0.03339	0.06991

V. RECOMMENDATIONS AND CONCLUSIONS

The objective of this thesis was to evaluate the performance of NROTC graduates attending the Surface Warfare Officers School Division Officer Course (SWOSDOC) between FY 1989 and FY 1992. The current Department of Defense budget situation has created the need for an objective basis on which to evaluate the performance of each NROTC unit. This thesis is a part of a larger research project that, when completed, will provide the means to evaluate the NROTC program in order to ensure it is maximizing the effectiveness and efficiency of each individual NROTC unit.

The primary goal of this research was to determine the SWOSDOC academic subject areas in which NROTC graduates are experiencing the most difficulty. The following are the academic modules that were found to be most difficult for NROTC graduates:

- Maneuvering Board
- Piloting and Detection Systems
- Gas Turbine/Diesel Engineering
- Shipboard Auxiliary Systems

While these subjects were found to be the most difficult of all the NROTC graduates studied at SWOSDOC, the actual mean GPA differences between all subjects was very small. Also,

the mean GPA of all subjects taught at SWOSDOC (3.65; 4.0 scale) was significantly higher than the mean GPA of all subjects taught at SWOS Basic as found in the earlier Heidt and Zajkowski study (1983). The mean GPA in that study was 3.50 (on a 4.0 scale). It was also much higher than the overall GPA computed by SWOS Basic for NROTC graduates attending SWOS Basic between FY 1977 and FY 1980. That mean GPA was 3.44 (on a 4.0 scale).

The small range of scores for all SWOSDOC subject areas and the increased overall GPA show a significant performance improvement for NROTC graduates attending SWOSDOC. The academic subject areas detailed above should be monitored in the future to ensure that greater difficulties are not encountered, but no major revisions to the NROTC or SWOSDOC curriculum can be recommended based on these results. Practically, the funds and time required to revise these curricula in order to correct the minute differences in SWOSDOC performance scores in these areas are too great in these times of force downsizing and budget reductions.

This thesis also looked at the effects of NROTC unit and college major on NROTC graduate performance scores at SWOSDOC. The results of these tests can most likely be attributed to selectivity bias in that those universities and college majors with higher selection standards will most often produce NROTC graduates capable of performing at higher levels than their counterparts from less selective institutions and college

majors. Therefore, no action should be taken to correct any unit or majors program found to be producing graduates with lower SWOSDOC performance scores in this thesis.

The last point of interest in this thesis was the examination of each of the individual SWOSDOC classes for the time period under observation. The performance of SWOSDOC classes has also increased since the early 1980s in that the overall GPAs are higher and the range of class scores is much smaller. Also, the attrition and setback rates of the classes studied in this thesis are much lower than those of classes studied in the early 1980s. Additionally, the comparison of the three major accession sources indicates that the graduates of all three are performing equally well at SWOSDOC.

One probable reason for this increased level of performance is the course revision at SWOSDOC that took place during the 1980s. This revision, which grouped the instruction modules by warfare area, has produced better educated, more capable officers entering the Surface Warfare community. The second reason is the improved NROTC program selection process. By selecting better qualified high school graduates for entrance into the program, the fleet is receiving better qualified and more capable program graduates.

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